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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

LOOSE-LEAF FIELD NOTEBOOK

9-137

K.M. Waage NOTEBOOK 6 1952

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IS AIN'T B.O.V.

aerial photos?

if so

where

are they

not at Yale

Prob. yes - see contents p. 1 of Nt bk 6.

JURASSIC PARKING

Y.P.S.

№ 9321

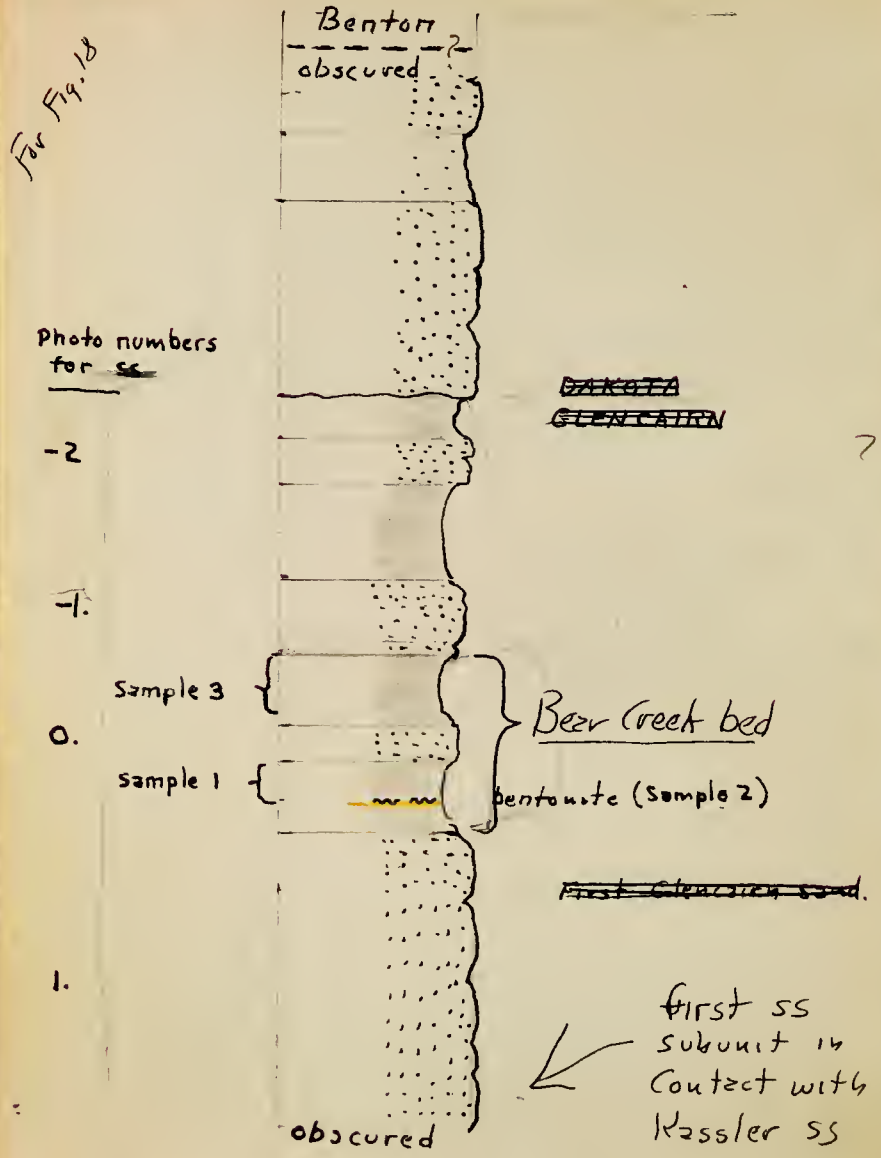
JUNE 21 - [illegible] Lee Doudy of Plainview who [illegible]
operates the 'Lakota' there -
Date for meeting of 28.

NOTEBOOK 6

AIN-49-08, 16. Section 1.

From Ntbk 6

1" = 10'



for Fig. 18

DAKOTA

GLENCAIRN

?

first ss subunit in contact with Kassler ss

AIN-49-08.

16. Exposure of sandstone with interbedded clay on top of rim ledge of hogback.

Section #1 (ascending)

Observer: I

150± Fine to med. gr. massive to ledgy, cross-bedded sandstone, lite gray to brownish gray

3.8 Finely silty ~~carb.~~ black clay, hard, blocky fracture, plant frags. About 1" of bentonite-like material 2.0 from top. [This bed is Sample 2] Below this is ½" bed hard silty clay then soft highly silty, clay, brownish cast shale, becoming progress siltier down weard. Basal .9 not fresh.
Sample #1 is of upper 2' above Bentonitic layer.

2.0 Siltstone grading upward to fine gr ss, lower 2± inches somewhat argill, all fizzed, rusty brown weath. - some rootlet impressions.

3.7 Shaly zone
.4 Shaly hard argill siltst.
3.3 Dk gr. clay sh. (weath.)
Sample #3

3.8 ± Sandstone, 10± upper, some shaly partings, lower ½ friable, upper ½ fine-gr. with silty [illegible]

1.

From Ntbk 6

AIN-49-08

(Section 1) cont.

5.0 Shaly zone, obscured by wash.

2.4 Fine gr to siltst. x lam, plant fragm brown weath.

2.2 Shaly zone
- .4 Argill. siltst.
- 1.0 Clay shale, some lt. sh'y siltst. dk gray. Thin micro beds siltst.
- .8 Platy siltst. with thin beds fine ss

Disconf.? weathered irreg. plated surface

10.2 Sandstone, fine gr, massive to ledgy, x lam. weathers brown. local plant fragms. Silty zone ± .5, 3.8 above base, breaks ledge.

3.5 Shaly or silty zone, obscured *

2.0± Sandstone, massive x lam, rd br. weathers, fine gr. Top to be top

* In ditch parallel to portion exposed, is white siltstone, loc. shaly irreg. bed, platy, plant frags.

17. Fossils from float. Those from upper flaggy layers within, and possibly near base of the second Ga... zone, below contact with ledge that forms rim of hogback N of scale. Found - Inoceramus comanchecanus; Pteria salinensis?; [illegible] float in wk ss from 2nd strat. lense [illegible] float

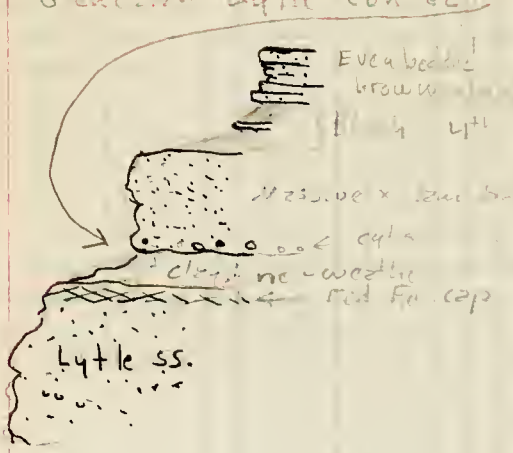
A817

2.

From Ntbk 6

AIN-49-08

18. Glencairn-Lytle contact:



To north ... zone contact is between ss & s... to put flow on.

19. Clay bed here. Crop indicates ... flow, cuts in top, about 4'. It is the uppermost of the 3 small clays under the oaks. May be worth prospecting here though thin.

Note - Glencairn-Lytle contact:- In this area some difference from Turkey Creek section where it is bl.sh. ou weath. clystn. Here ss unit, loc. cglte, lies between 3rd Glencairn sand and weath. clstn/or Fe capped Lytle-type sand. This unit resembles Lytle in its massive - x bedded structure, but commonly more dense & compact like overlying sands. Also tends to weather to brown rather than pink & orange brown as in Lytle sands. At AIN-49-06, 1., The 3rd Glencairn sits in sharp contact on this ss & 4th shale out. SS unit also sits directly on Fe cap of Lytle & weath clstn out.

From Ntbk 6

AIN-49-06

1. Section 1: From top Morrison up thru 3rd Glenrock

10.0± Wash covered slope covering contact Morrison – bentonitic? zone at base.

25.0 Sandstone, calc, mass bd, cross bedded light gray to white with pink & orange crown stain. Basal ~~2 ft~~ soft, friable.

4.0' Variegated clay/shale silty to sandy

30.5 Sandstone, massive, fine to med gr, cross bedded, pitted, tan gray worms gray pebbles, orange iron

5.8 Variegated clay/shale, mostly, thin red sandy pebbly

24.0 Sandstone, fine to calc, x-bed w/ some calc. nodules below. At top to 2' red. cone zones & Fe layers

Disconf.

0.6 Sandstone, massive, tan gray, calc. cement, x bed, brn weath.

13.8. Sandstone, cucullaea x bed, brn weath. plenty (Silicified) Nematodes worm tubes in thin lower beds.

12.0 Sandstone, fine grained, platy, with l.b. shaly siltstone. Cucullaea in shale lies above

Attitude top 3rd ss N 10W, 37 E

Totals-Lytle 89.3
- ss unit above disconf: 6.6
- 3rd Glenrock 25.8

From Ntbk 6

(2) Base of Dakota - a double clay bed here. One under Dakota somewhat difficult to trace to next draw north through scrub oak. N. of next draw N. this bed is continuous for considerable distance - almost to Weaver Gulch, & locally has plastic clay, judging from muck on outcrop. Some flinty layers near top. ☆

(3) Swale, some of 1st Glencairn ss may be in here but ss's are thick and to north no beds clay as thick as one right under Dakota.

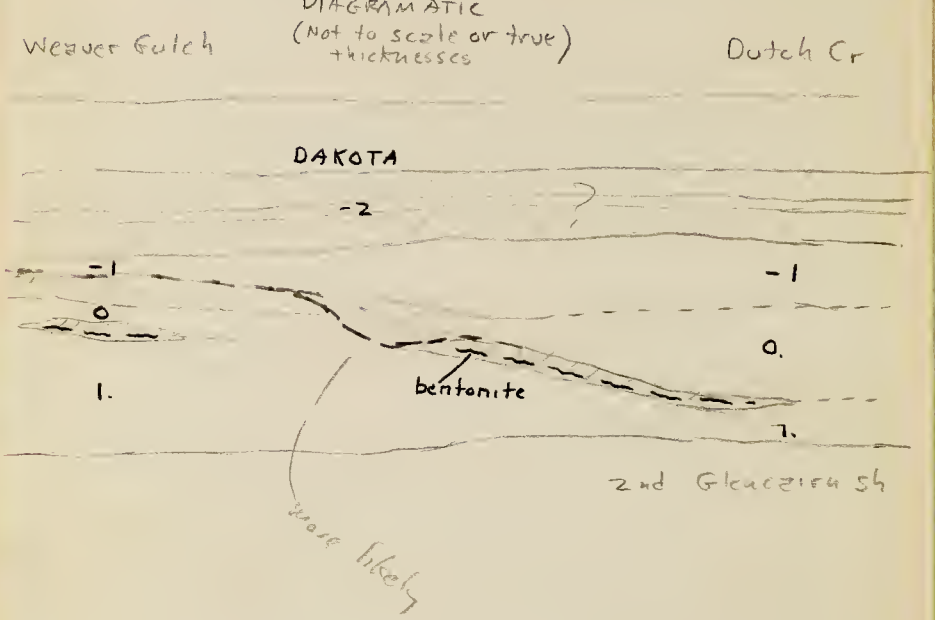
(4) First Lytle-like ss below 3rd Glencairn coarsly cgltic in upper 7'6ft. Pebbles up to 2" mostly chert + qtzite.

(5) Excellent Glencairn-Lytle contact, shows clearly that the x-bedded cgltic ss bed below 3rd Glencairn is in the Glencairn. Here this ss, which weaths deep rusty brown like other Glenssands, is massive x-lam, cgltic with chert pebbles up to 4" across. Sits on white fine to med. gr. friable Lytle sand. - See kodachrome

(6) Swale result of 1st Glencairn clay? with bentonitic zone lensing in. This means that this zone is out along most of the hogback from Weaver Gulch, where we sectioned it, to here. Possibility that this is not the 1st Glencairn clay, but the bentonitic clay is at base of about 2 ft. bed.

(7) Same clay as above in for 10'± here

Relationships of upper Glencairn clays in
Weaver Gulch - Dutch Creek hogback



12.3
29.3
41.6

(8) At this point the ss over the clay bed thickens abruptly and the ss under the bed thins. This interp. about only possibility. Thickness of ss over is exceptional.

(9) Clay thickens, shows following section

Sandstone ..... uncon f.

1.7 Light gray flinty clay ~~gray~~ becoming gray and less flinty downward [Sample 1
.9 Dark grey to blue black clay, subconch [Sample
.2 10 YR 6/2 soapy (cecling (bentonite-like clay) [2
scattered sand grains
(Seperate hand specimen of this clay is sample 3)
Below this bed clay is dirty, shaly silty

Note: Here sandstones 0 + -1 appear to coalesce to form cap.

(10) Clay bed pinches out completely as SS s above and below coalesce.

(11) Section starting from rear (4'±) top of (-1) sandstone.

33.0 – Massive cliff even-bedded, x lam. fine to med gr. gray ss, weathers brn.

41.6 – Massive cliff of fine to med ss, even-bed x lam, brown weath. Bench between this and cliff above seems to be from friable zone, is only on N. Side canyon.

uncon f

3.6 Shaly siltstone + siltstone in thin beds.

8.0 Platy very fine-gr ss and l.b. siltstone, forms characteristic slabby outcrop of yellow brown platy ledge.

35.8 ft. to top 2nd ss. along N 27° E
N 12° W 30° at base brown platey
Slope angle 14°
N 20° W 32° top of middle ss

14 6
4
16

3rd

Plat.- (see data above) From base platey to top of ~~2nd~~ ss some platy beds just above top of ss with I. cowzenchezuus. ss. is platy, grey, irreg. bedded, may be only lower part 2nd ss., is bed 3' thick + platy, below is sh with "bentonite in top. Possibly ledge mapped here as 2nd ss is entrained in zone of 3rd sh, with true 2nd ss observed by slope wash above.

~~Plat~~

23

12. Section from Plat 1" 3rd ss down.

Top 2nd ss

21.5 – 3rd ss, even bed x lam brn weath fine-medgr ss.

8.5 – Obscured – blk sh zone. Sh present in outcrop at stream level s side canyon.

3.) 9.0 – Sandstone, massive-x bedd brn weath

discon

21.6 Massive x bed grn-wh ss lens cgl ss, med-coarse

→ 36.0 Massive cgl ss

(Up slope to NW – red clstn parting comes in between these zss.

Approx. meas.

10.0± Zone red, yellow + grn clstn

17.0 Coarse to cgl ss, grey to pink to red, where high F. also pitted in red zones, friable at base

7.

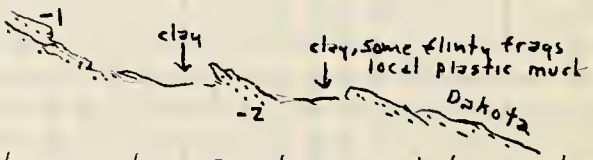
Below ss slope wash obscures, but patches red clstn. as far as 10 ft below, then green begins

Resume of hogback geology between Weaver Gulch and Dutch Creek:-

Clays between 1st Glencairn sand and Dakota

At Weaver Gulch 4 clay beds present, separated by sandstone units. None of clay beds thick, lowest has bentonite-like layer above which clay good, below which silty & shaly. This bed is probably main refractory clay bed. It pinches out a short distance S. of where section 1, AIN-49-08, taken. Sandstone beds betw. clays all relatively thin here, but south along hogback they thicken and locally coalesce. ~~Thes~~ Most variable are sandstones 0, and -1 (seep. I this ntbk). 0 locally increases to 25 or 30 ft near S. end hogback, coalescing at S. end with 1 and -1 to form solid unit of ss.

The two clay beds above -1 are persistent, varying in thickness from a foot to as much as 5 feet. No good exposures, but well-defined (double) bench on backslope -



One of thickest zones above -2, showing plastic muck, runs N & S of 19, AIN-49-08

Between 6 and 9 on AIN-49-06 the main refractory clay bed comes in and locally reaches 2.8 in thickness. This is its best for hogback segment in question. Locally it contains gray flint clay, somewhat silty, at top. Pinches out to N and S between sandstones 1 and 0.

Resume (cont.)

This bed also in for a few ft at 7, AIN-49-06 and at N. tip of hogback S. of Weaver Gulch.

Summary on clays— Main ref. clay bed out for most of hogback, too thin where in. Contains some flint locally. Upper 2 clay beds most persistent, obscured by wash, probably not worth prospecting. 3rd bed in only in N ¼ of hogback. Conclusions — no commercial ref clay in this segment.

Lower part of Glencairn

1st ss persistent & forms cap of hogback, joining with 0 thruout most of hogback and also with -1 at S end.

2nd shale contains platy orange-brown weathering siltst. & fine ss. Fossils found in some of these either just above or in 2nd ss. Relationship of 2nd shale, 2nd ss & 3rd shale obscure because all are more or less non-resistant & poorly exposed. Actual position 2nd ss not positively located. Identifying bentonites not all located.

3rd ss — unmistable thruout hog back. Underlying black shale in locally but more places 3rd ss sits on 6 to 10 ft bed of X-lam, massive, loc. calc, brn-weath. ss that is basal bed of Glencairn. Disconformity in some places betw. basal calc ss bed & clstn, other places ss on ss. Latter are sharp and spectacular. (Photos) Basal ss bed present thruout hogback

Lytle Lytle consists of as many as 3 benches ss, any one locally calc, sep. by variegated-mostly red clstn. Top is mostly soft argill ss, rarely a good clstn so no chance of weathered clay in this hogback. Contact with Morrison obscure as usual, but if 3 benches ss present clstn beneath 3rd usually green & undoubted Morrison; bentonite locally at top Morrison-

AIN-49-04 Massey Creek – Dutch Cr. hogback

① Clay bed comes in here – about 2' of good clay and some argill. siltstone + sandstone at base. Bed pinched out about 40 ft N + 15 ft south. Identity? no basal bentonite but its low in section

② Platy beds, underlain by irreg. bedded, rusty weath. ss with flinty, bentonite like layer capping it.

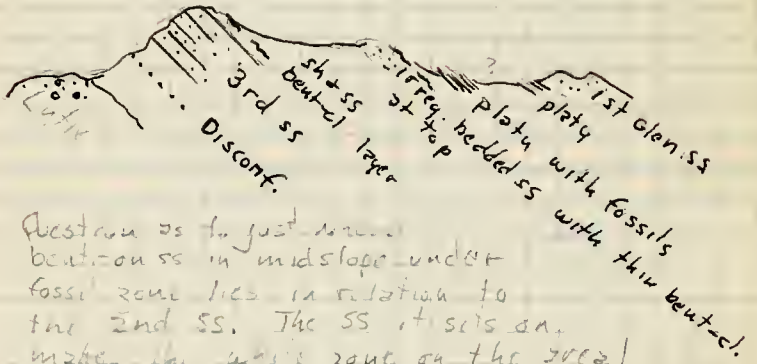
③ Main clay bed in here, bentonitic-clay at base, for short distance. Between 2+3 this horizon marked by wk zone in coalesced overlying + underlying ss. Local clay pebble cgl also marks it, but to of this type zone and relations of upper obscure.

④ Platy beds – in place, First clay bed in here, swings over rim and causes swale. In and out S of here about halfway to ③
Below platy beds thin ledge ss (top 2nd?), then slope, with platy ss ledge at base (3rd), the 2nd bentonitic layer of 3rd shale crops short distance up slope above it.
Below 3rd ss slope that includes 2nd bent. Then ledge cgl. Latie with Fe-stained top, about 10'+, then slope of l.b. ss & red clay then 40' ledge cgl. ss, red wash at base. This massive ledge is local.

North of swale the main clay bed pinches in one and between a thin (?) 1st Chinle rim and thin overlying Dakota. These 2 ss. make up the rim. Clay bed locally represented by silty & silty clay.

AIN-49-06 (Dutch Creek -- Massey Draw backtrack)

(13) Section 1 swale similar to other swale sections N along backtrack. Here first Glen sand then section as below.



Question as to just where bentonitic ss in midslope under fossil zone lies in relation to the 2nd ss. The ss at site on maybe the white zone on the areal photographs that I've been mapping as base 2nd ss. Check this against stratigraphic section. Fossils = P. selinensis, Inoceramus sp. and just below fossils the 'double crop' zone for sampling.

(14) First peat at rim S of Dutch Cr. No shale but shale pellet cgl & friable zone of ss. Probably horizon of thin clay bed

(15) In top transition zone many fish bones & scales locally on bedding planes. Scales up to 4" long drawn. Sampled.

(16) At least 2 claybeds, possibly a third in some places, present at mid-Bearpaw horizon. Base of lowest in section only one mapped. No mineable thickness indicated by crop width.

Resume of geology between Dutch Cr. & Massey draw:-

Exposures on west face poor except at the two peel-back areas along rim, where most ss. units can be identified. Even here the 2, 3 and other shales & claystones can't be sectioned. As result no measured sections.

Lytle consists of 2 benches, both calc. ss. at the ~~2 peeled areas~~ two swales in rim. Lower up to 40' & locally coalesces with upper. Still red wash beneath base lowest ss exposed. Upper ss bench 10 to 15' on average

Disconformity obscured, apparently in a soft zone.

Third ss varies in thickness, exposed chiefly in & adjacent to swale areas. Max thickness exposed about 20', may be additional soft beds locally.

Third shale obscured by wash. Its lower bentonitic clay crops out locally in swale areas.

Second ss. — its position, character & thickness obscure. (See AIN-49-06, 13) p. 11.

Second shale - no good exposures, platy bed under 1st ss is persistent.

First sandstone — at both Dutch Cr & Massey draw ends of hogback is combined with ss above and main clay bed is absent. At Massey

draw aggregate thickness close to 100 ft, at Dutch Cr about 75 ft. On hogback crm between both units thin appreciably, at one point each is about 15 ft or less thick. Clay bed between comes in at few places shown on AP's is never more than 2 or 3' thick. No indication of minor clay beds over main one — possibly because ss over main bed is 1) channeled or 2) thickened, excluding them.

Clay beds above ~~main bed persistent~~ this sandstone — ie in mid. Dakota are persistent. Definitely 2 separated by ~~main~~ ss from 1 to 3' thick. Crop stands out clearly on A.P.'s — and viewed from plains to east. No exposures of either bed. At Duck Creek end of hogback they are pinched out by ss for most part.

Note - The first ss of Glen is rather persistently even-bedded, contrasting with massive x-lam. ss of beds above.

Massey Draw — Deer Creek hogback

AIN-49-04

5. Clay beds in mid Dakota here, thin and silty, at least 2, probably 3. Contact drawn at base of these
7. on top of sandstone that covers most of hogback

AIN-48-93

① Clay bed comes in about 1/3 way up side of gap. Consists of some silty clay + siltst.; ss on top lifts, has interform structure in base. Clay bed rests on 2'± bed have ripple mrkd ss. and split comes in below this. Below clays ledge is 70 ft ± thick (est.). Clay at most is 6" thick — rest siltst + argill ss.

(2) Clay bed in at (1) continues best down slope to here. Split below comes with it and probably one or more thin beds above it. No bentonite-like clays observed

(3) Clay bed in here, gradually thins to N one pinches out at (3A). From 3A N, locally lost - may cross at (4) or more likely is bed that comes in again at (7). Could be main bed, then thins coming off rim at (1) and we have three beds here like one in Alamosa - Morrison hogback, then main bed would be in group that cross rim at 1.

(4) Clay pebble cgl at (local) uncont. Maybe clay horizon (see 3) pass off rim. Just north is small fault crossing fracture rim here, about 3' down to S.

(5) Swale with 2nd shale locally comes onto rim. Pore concretionary bed present at top, platy, near base of the shale.

(6) Discontinuity is ss on ss. 3rd ss relatively thin, not more than 5', and platy, lies on slope, ruins locally ledgy. 4th shale present, then basal Glencairn sandstone that is fine-med grained ss in thick unit massive x-bed, cgltic lenses, hydrocarbon seeps down from top of basal Glencairn

7.5. Sandstone, massive bed brn-weath, fine-med gr. crossbedded ss.

Discontinuity

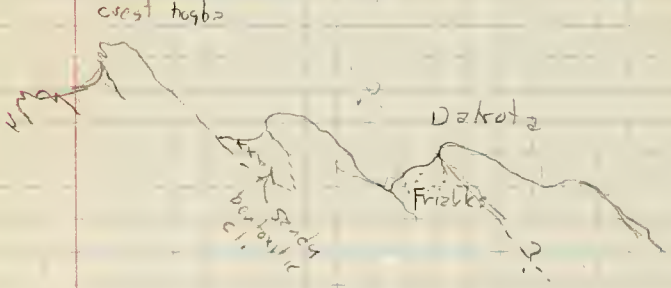
59.0 Sandstone* massive light gray, weath yellowish, fine to cgltic cross-bedded, base obscured by wash. Another ss bed about 8' thick, massive cross bedded, med to coarse comes in down wash covered clstn slope (that includes some red clstn.) Guess that it is about 30'- below ss above.

* Locally some red clst comes in 6 to 10 ft from top [cont. p. 28]

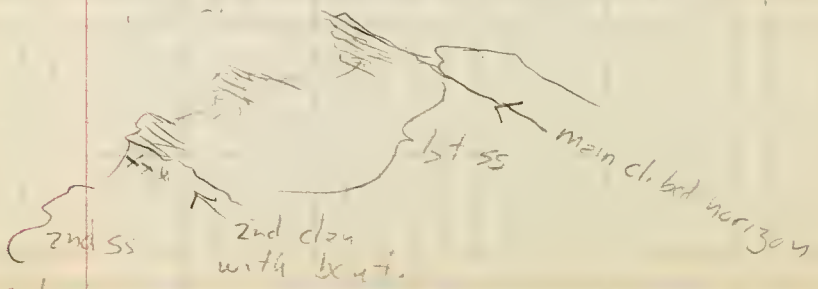
AIN-50-19 (Alameda-Morrison area)

16. Main clay bed continues into this swale from N. but is completely pinched out at south end, the first Glencairn ss coalescing with overlying sandstones at crest s end swale. As far as can be determined the friable sandstone is either in the Dakota or marks zone of other, little clay beds between it & the Glencairn

Diagramatic section thru. swale.



17. The first sandstone of the Glencairn changes to a platy, grossly cross bedded unit with intercalated shaly siltstone zones. This weakens unit and is responsible for swale in crest hogback.



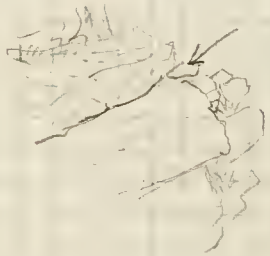
17(cont.) down slope. 2nd clay, with bentonite at top, recognizable, also 3rd shale with local pit in lower part. Down from this no outcrops in swale area

18. The main clay bed comes in again just south of high point and here shows some black clay with sandy bentonitic layer at base

19. Sandstones above main clay bed appear to be unbroken by any clays, can assume 1) all Dakota channeling in, or 2) The coalescing of sandstones 0, -1 & -2 with Dakota & each other.

AIN-50-21

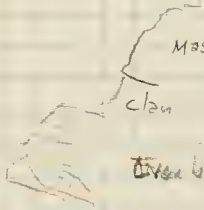
2. Main clay bed out completely here between the 1st Glencairn + overlying sandstone. Contact shows clearly in cliff face, with massive X lam on evenbedded brn weath ss



3. Plastic clay comes up back of & back in structural saddle. has 2 thin bentonitic zones in it and is capped by Dakota-like ss. Possibilities 1) it is in Dakota 2) it is one of upper 3 shale beds & ss below are greatly thickened 0 & -1.

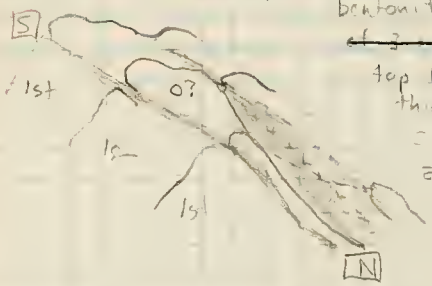
SEE NEXT PAGE

4. Massive ss's come up over lip, carry crest, which is broken up, and ~~begin~~ to peel slightly back down at 5, but do so only partially. Clay bed under crest from 4 to 5 viz



At 4 this clay is channeled out from above by rusty brn ss, just where top ss begins to peel back down hogback.

3 (Cont) Possibility ~~#2 present right~~ #1 mid-Dakota — same as at 16, clay with bentonite local ~~thick~~ lense, ~~and at 3 more clays~~. Clay at top 1st glauconitic just thin argill siltstone. Channeling complex this area, can't be certain of position clay bed relative to sandstones. (See 6 again)



6. Clstn at top of 1st ss comes back in here for few ft thin silty. Hogback between 5 and 4 on top 1st ss. ? ~~P sitting that big bo[illegible] clay with other the lower split, but this~~.

7. Measurement of 1st Glenaeon here - 55.0. sdst cliff, even bedded — cross bedded fine gr brn. weath.

8. Section down from base of 1st Glenaeon

9.0	Shale zone, obscured by wash, shows whitish clay crust with Fe layers
2.3	Sandstone, fine gr, medium irreg bedded, overlain brown weath ss. Lower 2-4 inches red Fe cemented cap on underlying ss.
2.6	Sandstone, lite gray, fine gr., irreg lumpy massive bed. Weath with over gr + brn streaks
2.1	Black shale, with silty partings
16.0	Sandstone, soft, fine-gr irreg bedded, light gray, finely disseminated carb. matter throughout. Weaths. with yellowish cast, Fe stained joints.
2.8	Interbedded silty clay stone, dk gr, fine gr. ss lite gr, + dk gray argill siltstone. Bentonite-like zone 0.5 from top.
5.0	Sandstone, double bed of fine gr, mottled lite + dk gray, irreg. bedded pitted, weaths yellow cast, O. parting argill siltstone in middle part.
2.6	Gray argill siltstone + silty clst.
1.3	Sandstone, fine gr to silty, similar to 5.0 above.
1.0	Slaby gray argill siltstone with 0.1 bentonite-like clay at base
4.0	Interbedded fine-gr ss, platy argill, finely carb, and argill siltstn.

(3rd SS) 12.1 Sandstone, fine to med, even-bed, x-lam, orange brn weath. Some friable zones with clay pellets + thin fissures about 8' below the very friable more massive

4.2 Wash covering more of friable ss Lower 4' are med. gr. ss in discont. contact with beds below

Discont.

4.0 Upper foot fine gr. ss, argill, white, yellow + ~~red~~ pink stain, grading to silty gray, stained as above cloth.

Obscured.

9. Outcrop of second clay, under prominent cliff of 1st Glencairn. Contains parcel[illegible]-like layer in upper part.

10. Section of Lytle.

Upper even-bed part 3rd ss

20.0 Lower more massive, liteqr-white fine-med ss, part of 3rd ss, yellowish to yellow brn weath, coarse at base

Discont.

21.0 Chiefly variegated silty clay stone, pink + white, with some Fe stained sandy layers about 5.0 from top.

12.4 Sandstone, fine gr, scattered small pebbles local. massive x-lam. weath yellow br. to pinkish, is liteqr.

6.0 Variegated silty clay stone gray, to red + yellow stain, becomes sandy at base + grades into

unit below.

9.1 Sandstone, massive, calcic, soft, weathers yellowish.

2.6 Clayshale, light gray, silty

47.0 Sandstone, massive, X bed, calcic, Fe pitted in lower part, calc throughout in thin streaks.

26.0 Slope wash over red + gray clayshale with some red silty beds. Green clsh + silt in with yellowish stain at base.

May be more ss about 20' down, but too much float to be sure.

11. Section of the 2nd Glencairn shale. Here 1st Glencairn channels top + this prob. accounts for absence of bentonitic bed that comes in along strike to N.

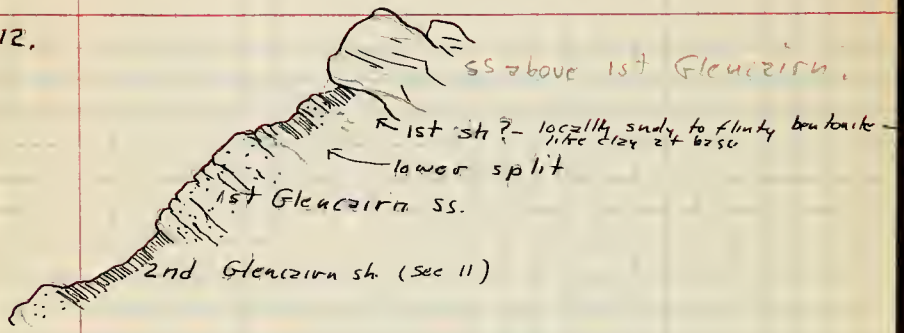
8.8 Black clay shale with thin layers ferruginous shale scattered through it becomes more silty in upper part. Base on 6" bed ferruginous silty siltstone.

Sample 1 - lower half
Sample 2 - upper half.

12 Hogback - capped by ss over 1st glen. clay, then descending to beaver which here has thin sandy layers near top, over white siltstone more clay covered. Then main body of ss, underlain by 2nd clay

over.

12.


ss above 1st Glencairn.
1st sh ?- locally sandy to flinty bentonite - like clay at base
lower split
1st Glencairn ss.
2nd Glencairn sh. (see 11)

13 First Glencairn ss and ss lobe - [illegible] coalescing, intervening clays thinned, appear on in and out ESE thru channel [illegible] clay.

14 130th clay bed (13.) peaks out about here but can be traced on breaks in cliff and local thin flinty beds.

15 Glencairn - Lytle disconformity; massive x lam to irreg bedded brn to yellow-brn ss on white fuzzable lse. argillss, stained orange, orange brn + pinks.

16. Clay occurs in [illegible] ?, with thin devel-oolitic zone near base. Goes over W. west face hogback here. Bed here about 8' with upper 5 mostly argillaceous.

Resume Alameda - Morrison hogback on AIN-50-21 and -50-19
Mapped — red lines W to E:

1. base Morrison - OK - on ss
2. Morrison - Lytle contact - approximate, on ss, red beds & vegetation - no clear cut separation
3. Lytle - Glencairn disconf. - sharp where exposed - good control except Neud

4. Dakota - Benton - approx on vegetation transition zone (top.)
5. Base limestone in Niobrara

Green lines, W. to E.

1. Second Glencairn clay.
2. First Glencairn clay +/or split.
3 Higher clay - may be mid-Dakota.

Lytle - highly variable, locally conglom., base not exactly located. For most part obscured by slope wash. Most complete section is Morrison section (10). See also section given AIN-50-21, 10.

Lytle-Glencairn contact, sharp, chiefly SS on ss. Black shale (Glencairn 4) not present, 3rd Glencairn sand thins southward Cct. AIN-50-21, 8, and section 10 (Morrison)) The 3rd ss consists of upper even-bedded part and lower massive x bedded part. Where 4th shale present at Alameda cut + vicinity it comes between these 2 beds, ∴ lower massive part probably = 4th Glencairn ss.

3rd Glencairn shale - typically sandy; contains usual 2 bentonites. Actually more ss than shale in this area. No shale beds worthy of note.

2nd Glencairn sand. - A massive silty, soft lite gray sand with some shaly partings, thruout hogback. Upper bed of 2 to 4' more resistant, brown weathering, is only ledge former.

2nd Glencairn shale. Persistant zone with porcellanite-like layer near top except where latter cut out by channeling. This only clay bed that reaches mineable thickness in the hog back. (See AIN-50-21, 11.) May be

6 to 8 ft throuout crop between AIN-50-21, 9, and 13, but only exposed at intervals. To north of 9 it is thinner, to south of 13 it contains increasing # silty, ferruginous layers, ~~The latter~~ but no good exposures as it is covered.

Kassler — 1st Glencairn sandstone shows unusual variation. In N½ of hogback it is thin bedded and grossly crossbedded, featuring rapid lateral changes with channels coming in and out. These include 2 shaly and/or silty lenses (both in at AIN-50-19, 17,) near northend hogback, presence of which probably responsible for swale at 17 thru weakening of ridge crest. From just south of Alameda highway to AIN-50-21, 2, it is crest forming sandstone, south of AIN-50-21, 2, it lies mostly below the crest and 35 above 1st Glencairn clay carries crest; exception between 4 and 6 of AIN-50-21.

VanBrupple — 1st Glencairn shale.— horizon can be identified along most of hogback by bentonite-like layer near base and relative-stratigraphic position. "Bentonite" locally flinty to sandy, but persistent. In some places, especially in south end, the lower split of this bed is present and it not always possible to distinguish between the two. At no place is this clay of mineable thickness — or even as much as 4' thick.

Shales above 1st Glencairn. - Some of the thin clays above main bed locally present. These are seperated from mid-Dakota

clay in most places by fairly good sandstone, but at 3 the ss between it & top Glencairn thins to few feet. Appears to be channel filled with clay. Same clay as at 16 (Morrison end), so fairly certain it is mid-Dakota — little flinty zones are clue here. Possibility still exists that this is one of 3 small beds over main bed — possibly the one with the bentonite-like clay further north. As it is not possible to determine this for certain & as ss between this clay & main bed maintains a thickness of 15' to 40' from Morrison south at least as far as Deer Cr., and is the massive x-bdd type typical of Dakota, it is reasonable to call it mid-Dakota in south of Golden, whether it is in Golden area or not. Brings up problem, however, of where to place Glencairn-Dakota boundary.

AIN-50-21 - Bear Creek to south.

17 to 18 :- Clay bed in Middle Dak. tz follows along between 17 + 18, crops out in very few places. Locally it appears to be at least 10' thick and at other places it is clearly cut by channels in which ss above is deposited. Thickness highly variable — grade unknown, would take prospect pits.

19 Lower bed not exposed here but crops out for short distance and shaly parting — represents clay bed channel — cuts coal for short distance

not recorded due to pile of debris

AIN-49-08 - South half of Morrison-Turkey Creek hogback

20 A Zone of main clay bed pebbles over heavy coal from here south to 21 is represented simply by silty ss with clay pebbles or silty zone or is cut out completely.

B Platey ss comes in under ledge of first Glencairn sandy shale & shaly siltstone [illegible] base of Ft Union.

21 Here the shale bed above main one comes in at crest of hogback is about 2' top of Dak. The shale grades out laterally, comes in again at 22. Main clay bed out.

22 Shale with clay pebbles main bed in for short distance

23 Shale above main bed in again & plets down the slope. At same time main clay bed (pebbles with its spit) comes in

Dakota? clay bed
at end Morrison
hogback.

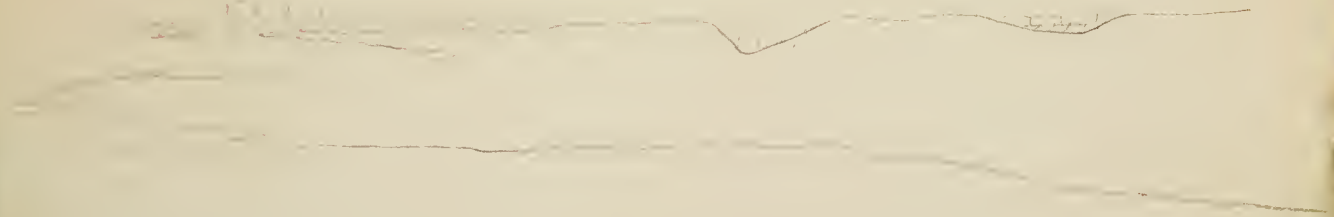
to form swale, but pinched out [illegible] S. end of swale.

Lee Doughty clay pit at Plainview.

Dips strike on the sandstone underlie clay
N. 20 E., 28° SE.
Clay is red clay, pit shows mixture with
gravel at edge, but plastic silty below
and beds. Only about 2' is bedded clay showing.
Clay companies in — Sewer pipe, Am. clay, Tile Co.,
Grade clays - 18-20 ft. ~~was~~ was for 15 years, but
~~don't~~ don't know.
Test for burning to 2350 before vitrifying melting, ~~would~~.
Using for tyle, bri- ~~-~~ ~~-~~ ~~-~~ ~~-~~ pots.
Opened in 1952-Spring.

Utigers Sinter plant

Tried Lorraine from Mt. Carbon - too sandy
Now testing basal Benton bought from
Robinson at Rustler mine. This seems
to be O.K. Not in production yet.



Massey draw → Deer Creek hogback (cont. from p. 14)

(7.) Clay bed in here, thin, peels off rim about as shown in A.P.

(8)+ Middle Dakota clay - double bed, see Deer Creek section for measurement + samples

(9)* Base of SS above the 3 little clays over main bed

(10)+ Main clay bed on top 1st SS

(11) Main clay thins - shows pinches out, ~~up~~ from 10 to here, basal plate angl. sandstone + silty clay remain, may be ~~split but doubtful~~. Broken or pinch shows here 12, not faulted up.

Across to 15 can be in the SS under mid. Dakota clay there is lower split of the clay bed up dip. All clays appear to thin abruptly [illegible] (from [illegible] section)

(12) Thick [illegible] shown as in here. It is either - I think will up in [illegible] or mid. clay and coming out clay, or lower Dak SS thickened - check

(13) Main bed in here and about 5'± thick. It thins to N and S.

(14) Top Dakota sandstone. Dakota clay ~~mostly~~ probably under it, then relatively thin SS capped clay and th 3 [illegible] clay beds

(15) Main bed, at least 5' thick in this swale area — A very good clay with less I

6554

* See Deer Creek ~~[illegible]~~ for detailed samples of these exposures.

leaves similar to those in Nahcolite cl'm.
in exposure in Deer Cr. gap.

(16) Section up from top of .

Massive x-bedd ss.

2.0 Light ~~olive~~ gray argill. ss & sandy clsty with Fe pink sandy layer

Disconformity

0.1 Ferruginous shaly ss, calcic. only locally present

8.0 Black shale, silty with Fe stng layers & silty grading in upper 3' to light colored shaly siltstone

2.0 Sandstone, fine gr, platy, brown weath

9.8 Silty sh. dk gray, l.b. gray silty layers, sh. in upper 2' - where thin ss beds also and weathers brown to ferruginous.

2.5 Sandstone, massive lite gr., brown weath, Fe brown irregular banding where bedding.

About this slope ... bed ... in slope. Hand ... by McL ...

South Massey #1
Ntbk 6 - p. 29
AIN 48-93 (16)

.1 0
8.0 0
2.0 0
9.8 0
2.5 0
2 2.4 0 S
4 7.0 0
4.1 0
1 0.0 0
1.5 0
1 5.0 0
1 0 0.0 0 *

1 McD here -12'±

Slope veg. N = 0

up to next ledge. [Dip of beds. N 21 W, 21° SE]
4 McD's to base of brown very local sandstone-thin
Total 47'± (2 McDs + 2.5 from bottom is soft ss ledge, fine ss irreg bedded crab. mottling light gray Fe stain, only .9 exposed) bedded to platy.

Measuring #11

4.1 - brown weak thin bed platy ss

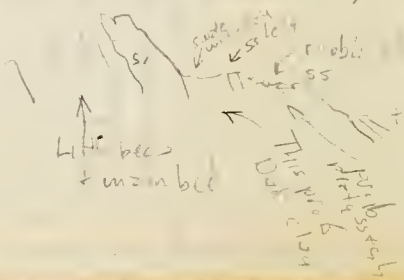
10.± - Slope with clay wash & platy brn ss float. Includes the "extra" bentonite

1.5 ledge platy brn ss.

15.± - Slope wash covering 2nd Cretaceous clay & silty beds at base.

(17) S. side Deer Creek. At this point Oahe clay goes under cover. It has fairly broad outcrop area but no good exposures between here & Deer Cr. Some ss in it but how much not known. Worth some exploration.

Clays up slope irregular, broken up by lense of lb. ss & silty clay, thin-bedded cross-bedded which can be seen to lense in & out from N side of draw (see oc photo (51)).



(16) Section showing position of fossiliferous beds. [N. 20 W., 40° SE]

Top of rim (well down in 1st ss)

A	10.0±	Sandstone, fine gr, even bedded x-lam. brown weathg.
B	2.8	Local lense of white very fine gr ss (lady silt?) fairly dense, with abund lenses. lower 8" silty shale, loc. cerp. Most lenses long narrow with prominent midrib.
C	23.0±	Sandstone, light gray massive x lam friable, fine with X beds medium-grnd and scattered flakes clstn. This in upper 15', forms local bench in ledge because of friable nature. Fe cement weathers out as irreg concretions. Lower 8-10' more even bedded x lam. Similar to A above but with med to coarse basal bed.

Base uncert.

D	3.5	Shale, obscured by slope wash, silty in upper part 4' from "bentonitic or porcellanitic zone at base.
E	3.5	Shaly siltstone and silty shale, weaths to slope with lite gray platy siltst. frags prominent under "bentonite". Small plant frags and some fish scales in this.
F	1.5	Platy siltstone + 1.b. fine ss, weaths in ferruginous ledge - ss brn + O brn, silt lite gy with plant + orange Plant frags
G	2.2	Platy to shaly siltstone minor shale (Similar to E)

2nd Shale sequence	H.	1.8	Fine ss and siltstone thin beds (up to 3 or 4") weathers brn to ft black, sandy beds predominate. Fish scales common fine plant trays. Some zones with fine shale pebbles, fish bones & scales. Inoceramus in float below this ledge and J below, no doubt comes from this ledge.
	I	1.5	Shale, with interbedded siltstone lt grey to black.
Bridge	J	22.0±	Siltstone & fine grained ss, massive light grey to buff, vertical Fe-stain fractures. Soft underlies slope in most places
	K.	4.5±	Slope in small ledges grey siltstone, ~~dk~~ grey silty to fine sandstone, bcm. 1 ft ledges.
	L.	4.0'	Shale zone, obscured by slope wash
	M	0.7	Fine gr. grey ss, carb matting, irregular bedded. Yellow powdery coating fillings & stains. Fossils
	N.	10.0	Shale zone with interbedded siltstone mostly covered but weathers
	O	29.0,	Sandstone, even-bedded x-lam. fine gr. brn weathering
	P	11.0	Slope with over small bench with ledges thin bedded ss prominent.
	Q.	7.0	Sandstone, even bed x-lam to cross bedded, fine to medium with clay bleb zones
	R	6.8.5	Sandstone with zones soft argillaceous ss (Zone at base under slope, ss as in Q above.
	S	10.8.5	Shaly zone covered with slope wash but local patches black carbonaceous

T. 6.0 Sandstone, fine gr., some med gr. zones, massive x'bdn to finely lam. weathers red brn

Unconf.

U 33.+ Sandstone massive x'bdn f to gr to white, with org. lite gr zones 3' from top, thin moves with cgl coming in.

Base obscured.

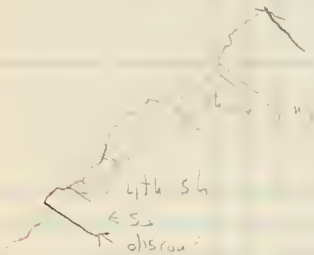
Notes - Great thickening of 3rd SS from last creek section across way. This can be seen on N wall of Deer Creek gap, with thickening by chert pebble zone coming in.

However, this thickening is due to local channeling into an underlying unconformity as it can be seen. Should be able to check this on N wall Deer Cr. Gap.

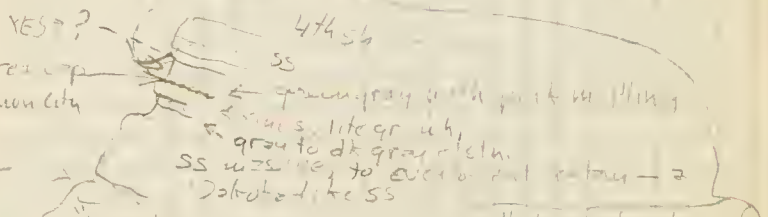
AIN-48-95

(1) Local clay comes into first ss — pass beneath it is 1st clay. It's horizon marked by coarse ss with clay pebbles. N of sw¼.

(2) Disconform. At this swell the 3rd ss is 2 cut bank 14 and 2' base ss resting on white Lyta



(3) Local clay [illegible] under discont



(4) Exposure of shale & plstn siltstone, ~~Loc~~ clay bed +5'. Bed is mid-Dakota. Could be sampled here

Deer Cr. Area - Resumé -

Clay beds - Main bed is at mineable thickness only in 3 small areas marked in red along green line. at AIN-48-93, # 13, #15 and ~~at~~ just N. Deer Cr. road.

Small beds - none of economic note.

Dakota clay - North of Deer Cr. best exposure is just N. Deer Cr. Road, remainder of outcrop N. to Massey draw is approx. with no info on clay — other than that it can't be very thick or it would show. South of Deer Creek indication that bed may warrant prospecting. ss on top thins throwing it way down slope very near Graneros contact - thus accessible. At AIN-48-95 #4 bed exposed & consists of shale & platy siltstones in lower part. This outcrop may be worth trenching.

Stratig. - Disconformity Deer Cr. section reexamined but little new info. - possibility discon. is on top massive coltic ss or is in it. At section AIN-48-93 #18 the 3rd ss is double (~~as at Blairview~~) a 4th shale is present and a basal ss is present. Farther S. AIN-48-95 #3 similar section with 2 foot basal ss. ∴ Great thickening of 3rd ss between Deer Creek section and hogback just S of creek. This thickening can be seen taking place on N. wall of Deer Creek gap. Question of whether a Dakota-like lense comes in locally under the disconformity (as at Canon) is worth investigating.

ov. top-

First Glencairn - a consistently thick bed. May locally include horizon of main clay and be joined with ss above this clay, but can't prove exactly where this horizon is when it leuses out. South of Creek main bed goes out abruptly and a coarse zone of ss with clay pellets that comes in ~~locally~~ near top of first Glencairn may be this horizon. A small amount of clay was found at this break in AIN-48-95, #1.

The plant fossils ~~come~~ commonly found mixed in float with marine fossils below first Glencairn, are from within first Glencairn - see section AIN-48-93 # 18.

37.3
33.4
4.

9 - 5 - 8 - 6 - 7

(5) Section of Dated Glenrock (part) in Nameless Draw N 15° W, 45° SE
From top of massive unit down (does not include thin shale & ss at top.)

A	33.4	Sandstone, tan-gray, [illegible] x-bedding, locally friable, massive, [illegible] & gray. Lower 4.6 has clay pellet cgl.
B	3.9	Obscured, probably argillaceous ss & silty clay zone.
C	4.6	Sandstone, massive, [illegible] white-weathering ss, upper [illegible] x-bedded.
D	5.4	Argillaceous, blue-gray weathering siltstone and pebbly silty clay, but obscured by slope wash. Locally [illegible] clay. Only clay [illegible]
E	15.5	Sandstone, massive [illegible] cross-bedding, tuffaceous. Scattered siltstone lenses light to gray
F	3.5	Slope with clastic rocks weak zone, [illegible] siltstone in float.
G	13.0	[illegible] cross-bedding, fine-grained [illegible]
H	4.0	Obscured weak zone, [illegible] gray silt.
I	24.0	Ss [illegible] X-bedding [illegible] cgl in clay matrix. [illegible]
J.	[illegible]	Slabby siltstone [illegible] interbedded siltstone & siltstone. Breakdown 1.0 [illegible] 2.5 [illegible] 1.0 Silty siltstone [illegible] 1.5 Platy [illegible]

[redacted]

[illegible] 2nd [illegible]
with [illegible]

Up dip [illegible] 1st ss goes into slope [illegible]
[illegible] forms rimrock.

Between [illegible] of section & 3rd ss beds
[illegible] 2' N. end [illegible] bogback. [illegible]
[illegible] section. 2nd ss in. type =
soft, shaly yellow to yellow brn weath.
with shaly siltst. ptgs.

(6) [illegible] top 3rd ss

[illegible] locally V. [illegible], brown [illegible]
[illegible] 25 [illegible] 30
[illegible] yellow [illegible]

17.8 Shaly zone, all but [illegible] 2' obscured by
slope wash. Blue shale below 2' with
[illegible] 6' [illegible] silty
[illegible] bed [illegible] silt
[illegible]. Thin siltstone
bed in [illegible] clsts underly.
only bl. shale above. Silty clsts
gets [illegible]. Discont under thin
siltstone bed. about 4' from base

(7) Continue [illegible] section E,
[illegible] massive ss below discont

37.0 [illegible] massive cross bedd. l. yn
[illegible] silt. light grey weathg
yellowish to yellow brn. cgl as
layers & lenses in sandy zone.
chert & qtz pebbles up to 2" diam.

20.0 Slope [illegible] covered, [illegible] clstn, variegated, s [illegible] [illegible]
9.0 Sandstone, massive, [illegible] crumbly, argillaceous zones [illegible] to [illegible] weath.
2.2 [illegible] silty clays [illegible] [illegible] siltstone with [illegible] massive [illegible] are irreg. bedded.

(8) Section measured down from bed J, 51

9.0 Slope [illegible] platy [illegible] much siltst. in thin beds, some [illegible]
3.9 Sandstone, massive, [illegible] [illegible]
32.5 Slope [illegible] sandstone [illegible] [illegible] upper part [illegible] [illegible] Some [illegible] [illegible] 5: [illegible] [illegible]
7.? [illegible], [illegible] with some [illegible] silty [illegible] [illegible] crumb. weath.
Top bed 5?

(9) Section [illegible] at gap, up from top of section at 5.
Note [illegible] of [illegible] (8) has 3 to 4 [illegible] with break or parting from [illegible] under it. The section below starts from top of this massive bed.

Strat'g. - Nameless creek gap -

Clay beds and 1st Glen. sand. - At gap are 4 breaks probably corresponding to main clay and 3 overlying clay beds. Clay present locally in each but appears to be consistently present only in upper 2, partic. 2nd from top. Intervening sandstones are all unusually thick. Most coalesce with selves and 1st Glencairn to N. and appear to do same to S. Thus Glen #1 is unusually thick in this area. Thruout Deer Cr - Nameless Cr hogback the main bed is cut-out, ~~one~~ exceptions are at the tip ends of the hogback - and possibly at AIN-48-95 (1).

None of smaller clay beds come in at a mineable grade or thickness. Dakota clay - which is very near

the top of this unit, holding well down at the base of the erst slope of hogback, may locally be thick enough but few exposures show it is full of siltstone at s end near Nameless Cr. (Belter near Deer Cr. end - see p.35).

Disconformity - As indicated in Deer Creek area, the disconf. is at top of massive coltic ss of Lytle type, featuring a basal siltstone bed under 4th bl. sh.. Claystone comes in under siltstone, for few inches, then Fe cap on Lytle-type sand. The basal siltstone is thin, may even be missing locally, at nameless Cr gap, but N. along hogback it thickens, becoming a 2' sandstone at AIN-48-95, ② where it rests directly on the Lytle ss.

Good exposures of disconf along N side Nameless Cr. gap (where section was measured) leave little doubt that the break is either 1) at base of black shale or 2) at base of fine ss or siltstone bed, rarely over 3' thick, that locally comes in at base of 4th shale.

The 3rd ss, which is thick, ~~probably~~ and 'double' locally as it is just S. of Deer Cr., shows no evidence of containing the disconformity within it and doubt any possibility of similarity to Canon set-up. Canon ss lense on Skyline is not like the 3rd ss in any respect except color - which is more like 'Dakota' than like typical Lytle. This isn't significant. Even the top of Lytle (as picked above) locally weaths like the Glen. Dak.

41

sands at localities adjacent to Deer Cr — this responsible for some of difficulty in picking contact, whose diagnostic features are much subdued thruout the hogback in Deer Cr - Nameless Cr. area.

B.O.V. -32-8. Nameless Cr to Platte River.

(1) Sample Ste. Quarry is clay bed. [illegible] Dakota clay. Is over upper big SS?

(2) Sample? Clay [illegible] Below this is [illegible] directly on upper platy sd. [illegible] Is 1st clay [illegible] Main bed of clay in area. Fossil ident. by presence of basal bentonite.

4) [illegible]

5. [illegible]

6) [illegible] hollow [illegible]

7) [illegible] 4th SS. The 3rd SS very thick in area [illegible] 4th SS. 4th quite variable to pinch out 3rd Later becomes more erratic to S. Rusty cgl float, really a very coarse cgl SS, in [illegible] 3rd SS at base — very [illegible] 1st SS or may not. [illegible] very coarse cgl in [illegible] river.

(9) Main bed beds in, attains mineable thickness along crest

10 Clay out. [illegible] to N

11 [illegible]

12 ~~[illegible]~~ Crop of Main bed, ~~with~~ 3" bentonite in silty beds below. Is base of Main clay. Clay ~~doesn't~~ [illegible] in #13

13 N 22 W, 49 E. Main clay bed in here with thick 5 - bentonite-like clays. Below this is thickest SS, then relatively good section down to the 3rd. SS. Then main clay thick SS [illegible] none of the small clays. Above the [illegible] present but no good clays. (See page 40 for [illegible])

14 Crop of main bed, 1st SS with friable zone in middle part — more of 2nd shale in here than in hogback to N. 3rd SS — only upper part, also in.

Resumé - Nameless Cr. to S. Platte - B.O.V. 32 - 8

Clay beds.- Main bed is in locally, basal bentonitic layer present and lower split. Latter has some highly carbonaceous plastic clay in it. Main bed of mineable thickness in two or three places (red-green line on photo), ~~not~~ split may be thicker than main bed locally — not separable in all places. Distribution of beds is too erratic to be worth anything.

One of 3 small beds in thruout the northern 3/4 of hogback, not thick or good enough but continuous bench former from short distance N. of Stone quarry. All 3 beds are out in S. end of hogback.

Clay in upper (Dakota?) beds is thin and silty. Definitely more than one bed. Trace on photo approximates position of these. No clay worthy of note.

Stratig. - Both 1st & 3rd sandstones thick. 1st has persistent chert-qtz cgltc coarse ss. at base. Discont. exposed (poorly) only at N end of hogback.

Golden Area. No. AIN-50-38

① Old prospect in clay bed, slumped into A'Dakota clay

② Outcrop at ~S, N. 20 W. 80° NE to ⊥ to high SW, ties boulder layer on NE side - this side a lens clay.

③ No rare sand crop possible observable

④ ~~Cut~~ Granite shale on fault contact with ~~Lyte~~. Layer sand boulder

⑤ Intrusive Porphyry to contact

⑥ N 21° E ⊥

⑦ Fault - Pierre syenite Dakota

⑨ Big pile - looks like ore Just to east of it is Te crushed rock - Dike to fault

B.O.V. 32-8 (13)

S Platte [illegible] - Section 1. Nevada Ranch, S side Hogback N. of S. Platte.

Section starts in Grasmere formation about 5' ft from top.

A	15.3	Plate [illegible] sandstone, sandy beds Fe stained, [illegible] ss at 5.0 (0.5 to 2m thick) and 11.0 (1.5 thick)
B	5.0	Sandstone, massive, fine grained, soft, weathers, poorly [illegible] Light gray with Fe brown irreg. patches
C	3.0	Sandstone, brown, [illegible] gray, [illegible] gray beds.
D	3.7	Sandstone, massive, fine gr. [illegible] weathers.
E	4.2	[illegible], Fe gray, s [illegible] 1.1 Silty, fine plant fossils 1.3 Plastic gray, [illegible] 1.8 silty, brown-gray, [illegible] 1.0 [illegible] silt-stone.
F	2.9	Sandstone, fine gr. evenbed. X bedded [illegible]
G	1.3	[illegible] fine. SS.
H	1.2	Sandstone as in F above
I	.6	Silty, s, sect few thin sandy beds
J	.7	Sandstone as in F above
K	1.2	Silty, [illegible]
*		Note: [illegible]

46

5.7
17.5
5.7
5.0
7.3
4.5
45.7

2.1
2.1
1.8
2.6
1.6
1.7
11.1

L	45.7	Sandstone, fine gr. - loc. med. near base, gray. weath. [illegible] to ½ brick. Basal 3-4 has clay pellets.
M	3.6	Clay zone - brick[illegible]
	0.4	Gray plastic shaly clay
	2.5	F.B. silty gray shale and siltstone. Lighter irreg. bedding to shaly, some layers fissile.
	0.1± (to 0.4)	Fe stained zone of brittle to plastic clay (Sample 1) ★ loc. concretions of iron greens.
	0.3	Gray plastic shaly clay
N	1.1	Fine gr. sandstone, platy - loc. silty, top grades to argill. siltst. light gray, brn mottled on weath. surface
O	.6	Poorly sort.? sour with loc. concret. Fe staining. Shaly zone in upper .3. (Sample 2.) ★
P	2.5	Sandstone, fine gr., massive, Fe cap - brown weath. on top surface covered with ripple marks.
Q	12.0	Interbedded ss - [illegible] 0.1 to 2.0 thick and with partings and [illegible] of silty siltstone gray. Weath. light - 1.1 gray, most silty beds in upper 2.1 with thin ss, below ss in thicker beds. Loc. Fe concretions, bedding [illegible]

44.6
10.0
17.2
71.8

R	71.8	Sandstone, fine to medium gr, irreg- bedded [illegible] to cross [illegible] with; zones intraform clay pebbles & [illegible] cgl beds [illegible] Upper [illegible] grey, [illegible] pebbles. [illegible] from top to top of [illegible] zone is 6 ft thick, ss full of clay pebbles, zone [illegible] V-bedded rather than to unc. Weathers, shows, is mostly a reddish salt & pepper with some small clay chips. Below this [illegible] to contact with Oil Basin chert gtz pebble cgl. Base of [illegible] intraformation, is cut by [illegible] to south [illegible] ocic up. Underside of base covered with [illegible] of water [illegible]? (Cambrian) or [illegible]
	Unconformity	
S	2.8	Intraformational platy sandstone [illegible] sandstone [illegible] shale in upper 0.3. (Cambrian)
T	1.9	Argill, plz & siltstone [illegible] grey [illegible]
U.	4.9	As in S. zone, with [illegible] bed [illegible] brn weath SS [illegible] [An Intraformational [illegible] conglomerate [illegible] 3 in.
V	5.4	Sandstone, [illegible]

		Siltstone in upper part grades down into silty clay shale. Shaliness obscured in places by [illegible]
W	14.8	[illegible] sandstone, salt and pepper gr. weathers light gray, with layered Fe concentrations in upper part. Cap is harder ledge 1.0 to 2.0 of brown weathering SS. Unit gets more friable, and silty in lower 5'. Fresh seep water finely disseminated on fresh surface.
X	1.5	Sandstone, light gray to tan on fresh, lite gr, irreg bedding. Not as [illegible] harder.
Y	1.5	Clay zone probably two units — .8 from top it gets silty, 72. 0.1 Fe-silt zone 0.1 from top. [Sample 4]
Z	11.4	Silt & Sh. Mostly, fracturing, grading down and to Siltstone. Upper most 0.6 to 0.8 is ledgy as in X, rounding. Under slope in most places. Some [illegible] ledges.
AA	2.5	[illegible] weathering pattern known.
BB	8.3	[illegible] Locally indurated. Thought to be [illegible] Spotty [illegible]
CC	8.7	Shaly zone, [illegible] shale with [illegible]

DD.	17.2	Sandstone, fine grained, [illegible]
EE	6.4	[illegible]
FF	5.8	[illegible]
G.G.	20.3	[illegible]
H.H	1.1	[illegible]
II	3.6	Platy to shaly fine ss & siltst. lite grey with some interbedded silty grey sh.
JJ	.8	Lodg ss Med - coarse [illegible]
KK	1.7	Argill, [illegible]
	6.0	[illegible]
	2.4	[illegible]

South Platte → Helmer hogback

B.O.V-32-85

A	21.5	
B	4.1	
C	6.	
D	7.0	
E	3.6	
F	3.0	
	45.8	
	4610	
G.	0.4 to 0.8	
H	7.6	
I	1.6	

J 26.7 Sandstone, [illegible]
to [illegible], local layers
cal, [illegible] qtzite.

K 2.3 [illegible]

L 8.4 [illegible]

M 7.7 Sandstone [illegible]
calc [illegible] of chert & qtz,
At [illegible]

Note = [illegible]

79 = [illegible]

U 2.6

P. 1.2

Q .9

R. 7.3

S. 10.5

T. Claystone?
(Sample 1.)

1,7
7,6
0,7
7,6
4,6
1,7
3,5
0,3
3,2
0,3
1,0
4,0
4,3
1,0
2,0
2,4

(2)

Tunnel

N 20° W, 10

2.1

1.1

C 2.0

D 0.7

E 2.6

F 4.6

G 1.7 **Lignite**, [Sample 1.]

H 3.0

I 0.3 **Bentonite-like clay** [Sample 2]

J 3.2

L [illegible] 0.2–0.5 Bentonite-like clay [Sample 3]

[illegible] [illegible] [illegible] layer, [illegible] [illegible]
[illegible] 0.2 [illegible] to medium [illegible]
Shaly [illegible] [illegible]
[illegible] [illegible] pockets
[illegible] scale.

M 4.0 Siltstone [illegible] fine ss, [illegible]
[illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible] [illegible] [illegible]. Thickens
locally [illegible]

N. 4.3 Sandstone, fine grained. lite gray.

O. 4.0 Shaly [illegible] gray siltstone.
[illegible]

P 2.0 [illegible] [illegible] [illegible]
[illegible] [illegible]
foot is [illegible] clay,
[illegible] plastic [illegible]
(Sample 4.)

Total 52.4 [illegible]

Note – B [illegible] N, O + P [illegible]
[illegible]
[illegible] st [illegible]
[illegible] section of N [illegible] P [illegible]
silty [illegible] thin [illegible]

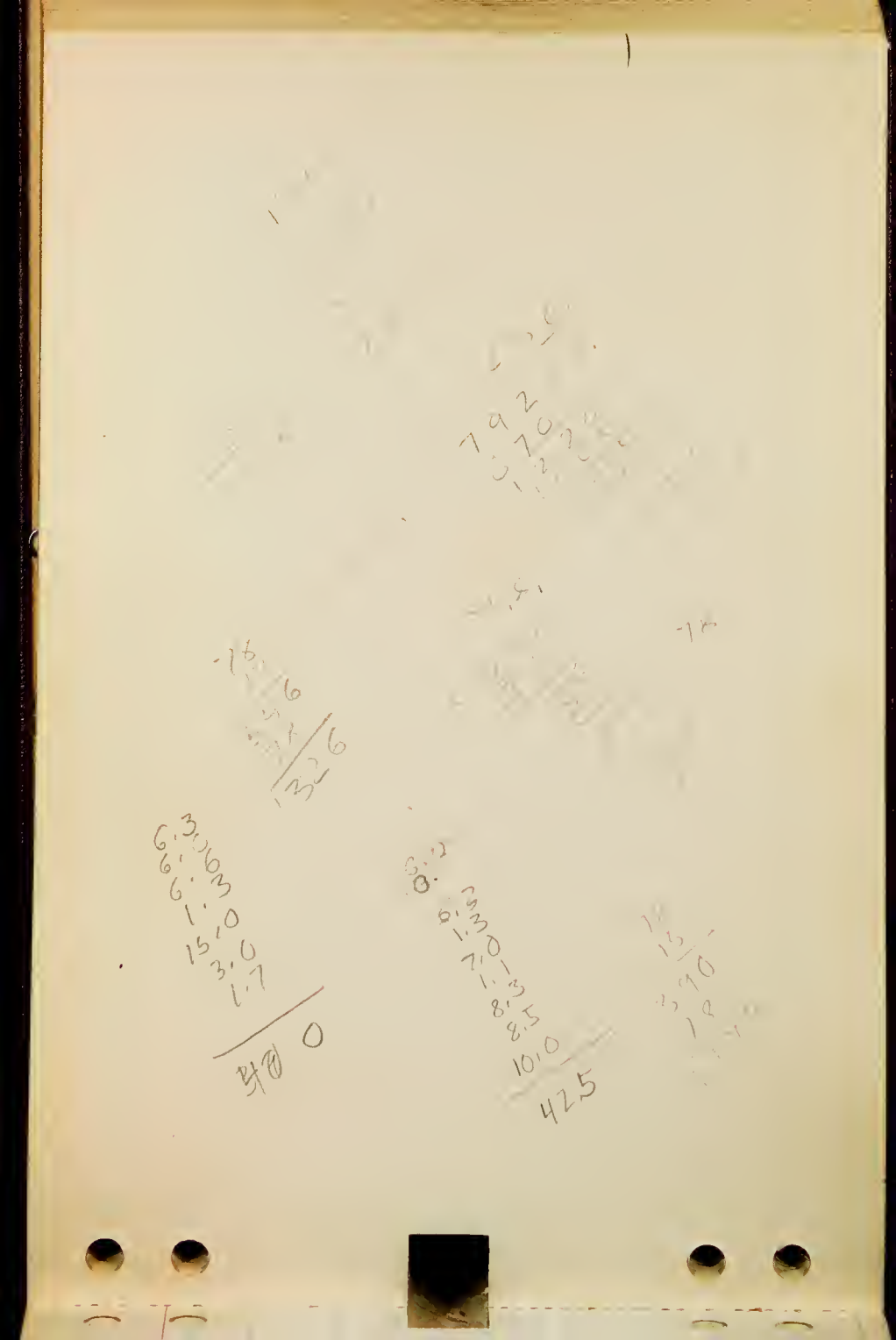
[illegible]

(4)

(5)

See [illegible] Mtch 7, p. 65.

(9) The lower split of the Dakota clay lense down to 2 feet of silty clay as ss. [illegible] below clay takes on additional lense viz.



3 cont. Up [illegible] bedding, massive, about 5' with much silty clay [illegible], & [illegible] clay at base.

(10) Main coal appears to [illegible] Small appears as coup traces. Beds above main [illegible] and [illegible]. Upper one has [illegible] in it. Trace of rib [illegible] made [illegible] of S. Coiling [illegible] and most be new.

(11) Old opening in Main clay bed. Clay pack [illegible] End 6' with 3" basal [illegible]. Swale [illegible] thinning in of main clay below main bed. Fauna similar from base of [illegible] down.

[illegible] bentonitic-like clay [illegible]

Section 1

A	1.3	[illegible] massive bed, fine gr., ripple [illegible]
B	7.0	Arg. [illegible] clay, local bedding ss [illegible] clay top
C	1.1	[illegible] fine gr.
D	5.3	[illegible] bed
E	8.5	[illegible] fine gr. [illegible]
F	10.0	Silty [illegible] shaly zone to p
total	[illegible]	solid wall of 1st Glen [illegible]

130'N just S of swale, following measurements from base, Main clay

Section 2

A	[illegible]	[illegible] massive [illegible]
B	6.6	[illegible] silty, flinty, gray bent-clay
C	1.3	Sandstone, [illegible] bed.
D	15.0+	[illegible] and small silts, ferns [illegible]

3,3
1,3
4,6
0,9
9,1
10,6
8,0

3,0
1,7

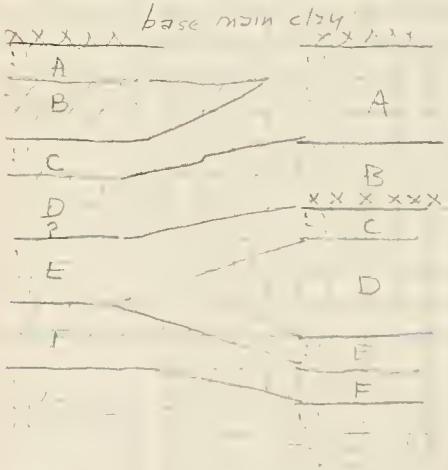
dense & mica-rich obscured by weathering

E 3.0 Sandstone, fine grained, friable
loc. argill. silt.

F 1.7 Shale, siltstone & sandy siltstone
Top of massive ledge 1st Glen Aire

Correlation as drawn out on crop.

S Section [1] Section [2] N



12. Plot of intervening sandstones, main bed thins, roughly around to W. face so that ss over it is coeval formers

Section [3]

3.3 [illegible] clay bed, silty [illegible] clay at base

1.3 - Ss, massive fine gr. Ripmarks top,

4.0 - clay bed = argill. silt

(1.3) 6.9 - Sandstone fine gr.

9.6 Clay [illegible]

10.6 - Sandstone, fine [illegible] soft mass x bed.

Bill Hedley — mining [illegible] from
Waterton Coal [illegible] Co.
In first of two [illegible]s.

6.2
0.9
2.9
1.6
4.3
15.9

0.0 [illegible] 5) Silty [illegible] sand lens.

Top [illegible] of sand

(13) [illegible] of cut (Jo 4 [illegible]
Slope [illegible]
6.2 S[illegible] in [illegible]
0.9 SS as above with [illegible] like bed [illegible]
1.3 to 2.1 [illegible] plastic, grey sandy clay (Sample 1)
1.6 Angular [illegible]
4.3 Clay, grey fine [illegible] plastic (Sample 2)
0.5 bed silts [illegible] from nose.
Top [illegible]

(14) [illegible]. re-open[illegible] clay [illegible] in 145 [illegible]. [illegible] [illegible] from waterlain sand and clay [illegible] work together.
Main bed [illegible] one below it not mined.

(15) Just after Main bed crosses to west of crest, going south, both main bed and one below it are thick. Lower one shows good clay float (Sample 1) over limited strike area - local pocket that, as usual, coalesces to low point in hogback.

(16) N 25 W, 56° E Main bed going [illegible] E side [illegible] building crest for coal [illegible] Clay [illegible] under it, between about 6' [illegible] of 1st Glen Sp. [illegible] bed ± 4, but thins to east or so [illegible] thins else about 50' [illegible] base Main clay about 4' from top 1st Glen with 2' [illegible] shale [illegible]

(17) Lower split out [illegible]

(17) [illegible] 60 ft. to coal shale in about 2 ft clay in first 4 ins,

(16) Main clay bed opened here. Is typical of stuff from Healey mine to here. A fair grade of fire clay with many thin beds and laminae of siltst. Silica 30+% and scattered thru bed 5.0+.

Fuzzy cs below 1.5 ft in SS no bed clay exposed.

(14)
Healey Mine section (not sampled)

5 foot bed clay under massive x bedded ss.

1.9.	Clay with thin interbeds silt, best clay in this layer. dk gray finely silty to non-silty plastic
.6;	Banded siltstone
.3.	Fe silt + silty cl.
.4	Banded siltstone
.9	Clay with interbeds silt
.7	Banded siltst.
.2	Clay
.3	Bentonitic clay
1.4	sandstone, fine gr, massive bed
2.4	Highly silty hard gray clay shot thru with rootlets
1.+	Argillaceous brn gray siltst.

1+

21

22

23

24

62

25. Clay bed comes in next, very similar, same as to that at (23). Considerable SS over it, clay below for Dakota clay. — Note — is lower split main clay.

26. 1st (?) Sandstone, [illegible] to coarse with lower [illegible], just above coal zone is seen channel same as local lense.

27. Discontinuity — lies ——— in wash covered slope between. Sandstone about top Lytle Ss, a good 5' to 8' wide, white in color in at least part cropping. No coal, few scattered pebbles, local fine pebble lag surface.

Note on clay pit: Main bed after pinchout at (21) not traceable, but would guess horizon lies mostly E of creek. The clay that comes in at (23) not identified — it splits at main bed. It is very low in slope, yet from far between looks like clay that comes in at (25), which lower split Main bed comes in at (28); the lower split sands out into gap, Main bed crosses, lies between S's on other side.

28 Main bed ~~5'~~ 4'± with basal bent. ~~clay~~ ripple marked surface (picture)

[illegible] on Dakota clay: If bentonite clay is in at all it is at bench in steep rock slope along east base hogback. Local silty beds crop out in [illegible] near gap. No good clay seen. Bed must be within 10'± Graneros contact. Structures contour out variously but assume near last 25' dip, crop in gap.

B.O.V. 33-83

① Clay bed (Main) in here 6 to 8' silty layers, basal bentonitic clay present. Thins to south and by ② one of small beds is in over it as base Dakota climbs

② 3 clay beds in slope. Main bed on ridge side, then one of small clays above it in locality up to 5' thick. Dak ss above it thinning, Dak clay in locality over ss here. Looking across gap seem that Dak ss cuts down & all but pinches out main clay, while Dak. clay is quite thick & obviously lenticular (See radachrome.

NOTE RE DISCOVERY

Heimer section:- Dakota in shaly zone. Later. 3rd ss & 1st ~~Entire~~ 3rd ss thin here (see sect.)

④ Old quarry S of Heimer gap.

Section up from base main bed, surface of which exposed over big area & beautifully ripple marked. N 20 W, 65 E (measuring up)

A	0.2	Bentonitic clay
B	2.6	Clay, shaly with thin interbeds silt.
C	40.0	Sandstone, massive & bedding plane, fine gr. uniform th
D	9.0	Interbed fine grass in beds 0.1 to 0.8 thick, and plastic shaly clay ~~south~~, finely silty, with some layers & lenses silt. Carbonaceous in some layers almost lignitic clay. Upper 3.8 to 4' massive plastic clay with .8 to 1.0 cap of platy siltstone fine ss.

64

E	~6	As above [illegible]
Unconformity?		
F	9.3	[illegible] to medium. This bed shows evidence of steeper dip than low ½ may be local fault in it.
G	3.5	Limestone [illegible], loc X-bed, in beds 0.1 to 1.5 ft. thick, and thin partings silty clay.
H.	2.0 to 4.0	Clay, thicker beds up dip, gray plastic, no silt.
I	3.5	Sandstone, massive, fine grained.
J.	1.8	Clay, brown, gray plastic silty
K.	6.4	Soft, [illegible], fine grained
L.	0.2	Bentonite zone - soft yellowish clay
M	2.2	Ledge fine grained.

[illegible] than 7' [illegible] to Ground surface interval is true section [illegible].

Note this section may be faulted, fault going through unit F. Attitude on ss bed I = N. 10 W, 65° E. Attitude on some of platy beds in D. is same, but others show [illegible] some [illegible] between.

B.O.V. 33-83 (cont.)

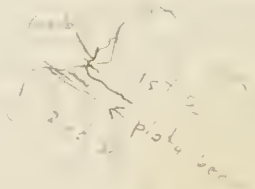
3. Quarry in ss, fine gr, tran wedg. ss. Sues Main ss

4 Clay and siltstone. — Dakota clay.

5. Main bed in N of this knob but cut ~~down~~ out here. Split is present as silty zone, minor clay. Main bed has basal bentonitic clay. Is 3' thick just S side cut on and on N to quarry at end of ridge it varies from 3 to 8 ft as overlying ss channels in + out. Attitude on ss base of clay N 20 W, 65° E
South from cut out at 5 split becomes sandy zone.

6. Thin silty clay in here for some just W of crest, may or may not be force main bed. No bentonite or rip ss

7 Cross bedding ... 1st ss forms crest and train main bed — prob compl cut but must be down & slope. On west side bench just below crest held up by slightly resistant 2nd ss. Base



part 1st ss friable, rests on platy bed. Dip on 2nd ss 45°, Dip on 1st is 4/5, so dip ... flattening out since (E) shown. Platy calc ... at top 2nd ss are 12 to 15 thick. ... ty + shaly zone below ... than main 3rd.

disconformity between ? and bench at first Lytle SS from 3 to 15' below. Lytle obviously is thickening.

8. [illegible] back in here about 3' and thickening to 5'.

Betwe[illegible] 7 [illegible] ridge [illegible] [illegible] lower part [illegible] very friable & [illegible] quod [illegible] This[illegible] [illegible] [illegible] beds [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] Lytle [illegible]

9. [illegible] at crest, [illegible] sand wash marks base 1st Glauc. [illegible] near [illegible] ~~to west~~s top west scarp

10. Ly[illegible] [illegible] with quartz [illegible] [illegible] [illegible] chert & chertified wood. [illegible]

11. Ripple marks [illegible] top [illegible] just [illegible] plain beds. Oscillation ripples. 1.1 between crests. Above this platy beds then 1st Glauc with cgl. based part — see section taken [illegible] 1951

12. [illegible] clay [illegible]. Clay bed opening [illegible] in a bed directly [illegible] bed and separated from it by 3 to 4'+ of SS.
[illegible]

13.
14

15

13+c

14.2,

7.9

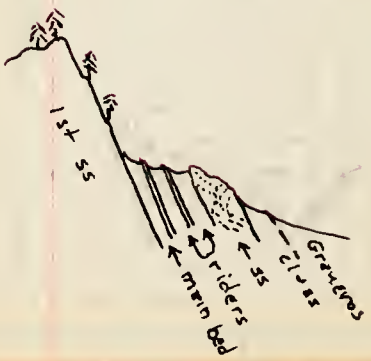
3'+

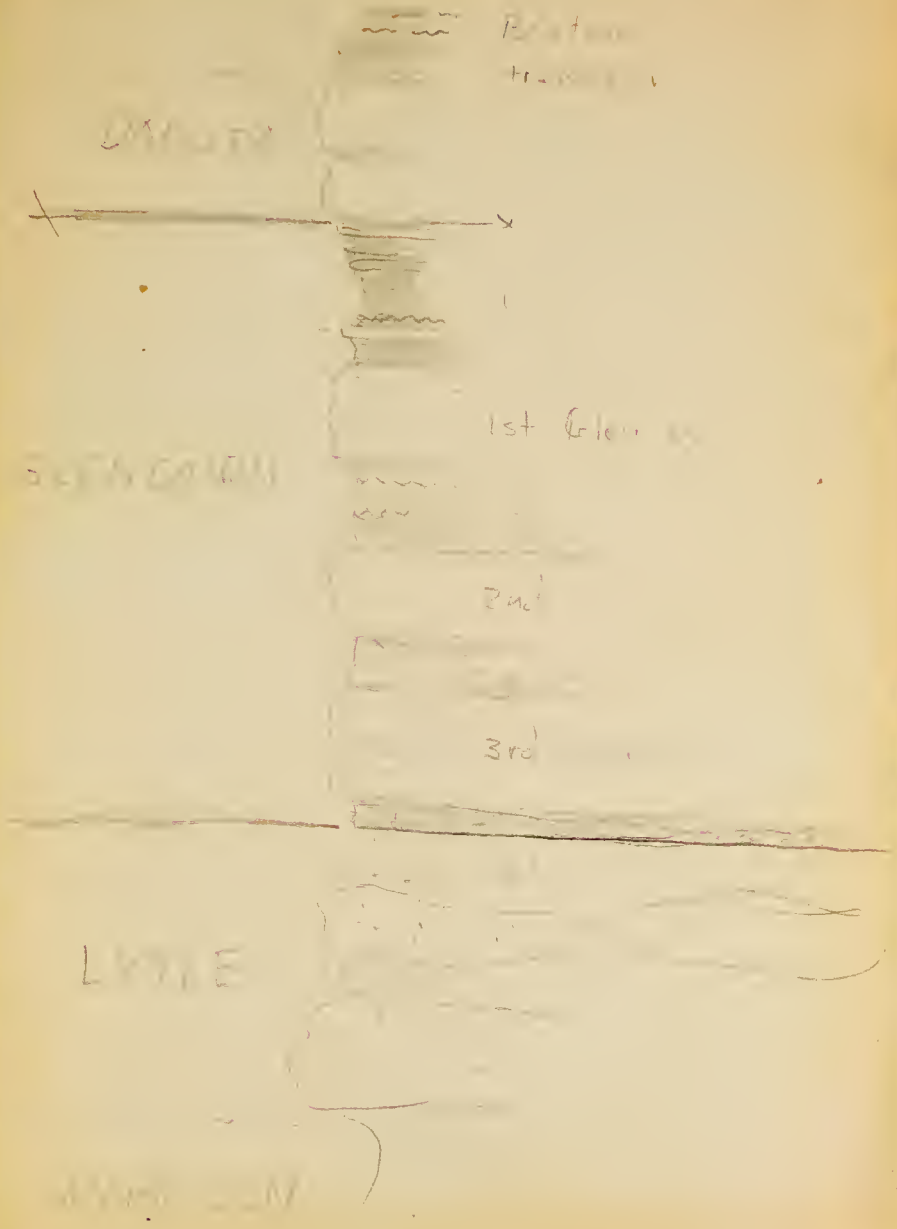
10±

16.

18.

19.



Resumé – Clays south of South Platte River.

Main bed: Begins to come in at end hogback N. of South Platte, but largely silty. South of Platte bed is in and out [see maps] In general, clay contains considerably more siltstn. than in other mining area near Golden. Is characterized by middle silty part (see sections of it from Verdos section south.) Probably would not be exploited in this area were it not for other clays associated with it.